Absorptiemetingen aan eenige metalen

Lameris, Pieter Frides

Publication date:
1936

SUMMARY.

This thesis deals with experiments made in order to obtain very exact and trustworthy values of the reflecting power of the metals: silver, gold, platinum and tungsten. The observations were made on these metals in the spectral range of 1—13 μ, both at roomtemperature and at the temperature of liquid air. Besides measurements were made on tungsten in the spectral range of 1—0.24 μ, at roomtemperature only.

The methode applied in most cases up to the present is to measure the intensity of the light both before and after reflection, the quotient of the intensities giving immediately the value of R. As the reflectivity of metals in the infrared lies very near 1 however, only a small relative accuracy of 1—R can be obtained, as is also evident from the results of previous authors as Hagen and Rubens a.o.

For the experiments described in this thesis a new method has been used which eliminates the difficulty mentioned above. The metal, the reflectivity of which is to be measured, is part of the receiver of a thermo-pile. Another part is blackened and may be assumed to absorb the whole of the incident light. We have only to measure the galvanometer deflection when the light falls on the black surface and to do the same when it falls on the metal and the quotient will give the absorbing power A of the metal, which is equal to 1—R. Now the light absorbed by the metal is only a hundredth part of that absorbed by the black surface and therefore the relative accuracy of A is greatly increased. Some further advantages are, that a perfectly polished optically plane surface is not required but only a brilliant one and that there is no necessity to introduce any corrections for the absorption of water-

vapour in the air. Also the construction of the apparatus is such as to make measurements easily possible at the temperature of liquid air.

The construction of the apparatus is described in detail in Chapter I and sketches are given in the figures 1 and 2. Fig. 1 shows the optical arrangement of the entire apparatus, while fig. 2 shows the details of the thermo-pile and also the way it is built in a brass tube and in a glass tube, which is closed respectively by a quartz or by a rocksalt window in the spectral ranges 1—3,3 μ and 3,3—13 μ.

In Chapter II page 27 an instance is given of one measurement, while the measurements on page 29 give an idea of the accuracy attainable even at the longer wave-lengths where the galvanometer deflection is a few mm only. As to the material used, a technical foil was found to give the best results in the case of silver; gold and platinum foil were obtained from Heraeus and tungsten strips taken out of special Philips-lamps. The surface of the material was not subjected to any process before its insertion in the apparatus.

Tables 8 and 9 show the final values of A obtained by the measurements.

Our values for A (fully drawn curves in the figures 3, 4, 5, and 6) are lower than can be expected from the classical formula $R = 1 - 2\sqrt{\sigma/\nu}$ (dot and dash curves), also lower than those of previous authors (tab. 10 and 14), but they agree better with Kronig's formula $R = 1 - 2\sqrt{\sigma/\nu}\,(\sqrt{u^2+1}-u)^{\frac{1}{2}}$ (dotted curves in the above mentioned figures) as the bracket is < 1.

While this formula does not permit a quantative comparison between experiment and theory, we found for the half-breadth δ of the absorption line at the frequency $\nu = 0$ values from 10^{13}—10^{14} $\sec^{-1}$ in agreement with Kronig's prediction of this parameter, by using the measured value of R and taking for σ its macroscopic value. The comparison of the temperature influence with the Kronig formula showed that the theoretical influence is far greater than appeared from the experiments.

The same method was applied (Chapter V), only with a modified spectral arrangement (fig. 8) in measuring the reflecting power of tungsten at roomtemperature in the spectral range of 10.000 — 2.400 Ångström. The final results of these measurements are found in table 16. The values compare well with those of Hamaker, who measured on the same metal using a different method (fig. 10).